REDLAKE

1.0

MegaPlus© ES 1020

User's Guide & Operations Manual

REDLAKE
1.800.462.4307

PRECAUTIONS

WARNING!

LIFE SUPPORT APPLICATIONS POLICY
MegaPlus cameras are not authorized for and should not be used within life support systems without the specific written consent of Redlake MASD, Inc.

NON-CRITICAL MEDICAL APPLICATIONS
MegaPlus cameras must be grounded to building earth ground while operating. This camera has passed IEC 601 class B standards.

The voltage drop on the camera's power return line must be less than 0.5 Volts DC. Use a heavier gauge power cable to reduce the voltage drop below 0.5 Volts DC. For medical applications, any power supply connected to the camera must meet IEC 601 specifications.

Absolute Maximum Ratings

Input Voltage: 10 to 16V DC
Storage Temperature: -55°C to +70°C.

Recommended Maximum Ratings

Input Voltage: 11 to 14V DC
Internal Operating Temperature: -0°C to +85°C.

Recommended Operating Conditions

Input Voltage: 12V DC ± 0.5V
Internal Operating Temperature: -0°C to +65°C.

ESD

The camera contains class I static sensitive parts. Appropriate precautions should be taken when handling or connecting or disconnecting cables.

FCC DECLARATION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

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1. Introduction

Overview

The MegaPlus ES 1020 is a high-resolution CCD camera provides real time digital imaging and is capable of capturing up to 48 frames per second with a spatial resolution over one million pixels. The ES 1020 version of Redlake's ES Series is lighter and more compact than its predecessors and uses the latest technology including Camera Link (CL).

The MegaPlus ES 1020 uses an interline transfer CCD with progressive scan readout and microlenses, which provides good sensitivity without sacrificing speed. The camera outputs 8- or 10-bit digital images with up to 1024 levels of gray resulting in high contrast detail.

The camera also features a built-in electronic shutter with exposure times as short as 35 microseconds for maximum flexibility and performance when capturing images of fast moving objects. The triggered double-exposure mode captures two images just microseconds apart.

With outstanding speed and resolution, the MegaPlus ES 1020 is ideal for machine vision, PIV, semi-conductor and electronic inspection, microscopy, and other applications requiring cost-effective, real-time image capture in a compact efficient package.

Camera Features

- **Kodak interline transfer CCD sensor – Monochrome or Color**
  - Front Illuminated Interline Architecture
  - KAI-1020: 1004(H) x 1004(V) Photosensitive Pixels
  - 7.4 Square Pixel Size
  - Progressive Scan (Non Interlace)
  - Electronic Shutter
  - Dual Output Shift Registers (Left/Right or Odd/Even))
  - Anti-blooming Protection
  - Low Smear (0.01% with micro lens)
- **Camera Link (CL) interface base configuration**
- **Trigger is controlled through the CC1 Camera Link channel**
- **Single 12V Power supply**
- **Low Power (< 4.2 Watts)**
- **Compact size**

2. Setup Guide

Before you Begin

Before you begin to setup your *Mega*Plus® ES-1020, please verify that the package you received contains all the components listed on your packing slip.

Minimum Package Contents

(1) ES-1020 Camera
(1) Mounting Bracket
(1) CD with Camera Control Software & User's Manual

Optional/Addition Items

(1) Camera Link Cable with MDS-26 connectors
Camera Link cable must be purchased separately.

(1) Strobe/Trigger/Power
Also available for purchase separately is a Strobe/Trigger/Power Accessory cable.

(1) Power Adapter
The ES 1020 requires the use of a Power Adapter with 110/220V Cords which must be purchased separately through Redlake MASD, Inc.

Lens(es)
Because every application is different with varying focusing and field of vision requirements, the ES 1020 is not shipped with lenses. They must be purchased separately.

Minimum/Recommended System Requirements

Minimum
• Pentium II, 233 MHz Processor
• At least 32 MB of Ram, 64 MB Recommended
• Frame Grabber Board with Camera Link Adapter (base configuration)
• 20 MB of Hard drive disk space available

Operating System Requirements

Once you have selected your PC, ensuring that it meets the minimum configuration for your application, make sure that it is running a Microsoft Windows™ operating system, Windows XP, Windows 2000 Pro (service pack 2) or Windows NT 4.0 or later.

Software Installation

The ES 1020 Camera Control Software provides all camera control functions, and is designed to be run concurrently with the image acquisition software that is provided with the Camera Link frame grabber board installed on the host PC.

A few basic steps are necessary to install the software needed to control both the frame grabber board and the camera.

CameraLink Frame Grabber Board Image Acquisition Software

The ES 1020 is designed to work with frame grabber boards adhering to Camera Link standards. Before setting up the camera, ensure that the frame grabber board and software have been installed. Please follow the instructions outlined in the frame grabber manufacturer's documentation.

NOTE: *Frame Grabber Boards currently certified to operate with the ES 1020 Control Software at the time of this printing include:*

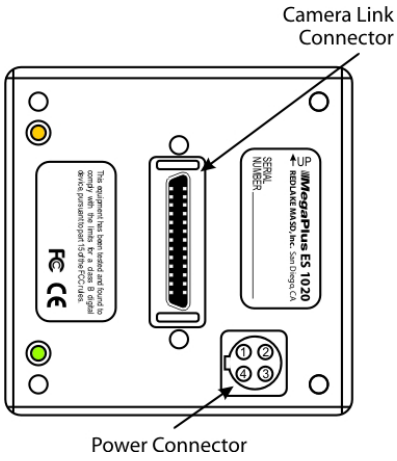
- *Coreco Imaging PC-CamLink*
- *Matrox Meteor II Camera Link*

Launch the Frame Grabber Image Acquisition software and ensure that it is configured properly to communicate with the ES 1020.

ES 1020 Camera Control Software

1. Insert the Redlake MegaPlus ES 1020 software CD. The software install process should begin automatically. If it does not, browse the CD and double-click Setup.exe. The install wizard with guide you through the rest of the setup process.

Hardware Setup



Connect Camera Link Cable

1. Connect one end of the Camera Link cable to the ES 1020, and the other end to the Frame Grabber board installed in the PC.

Connect **Power Cable**

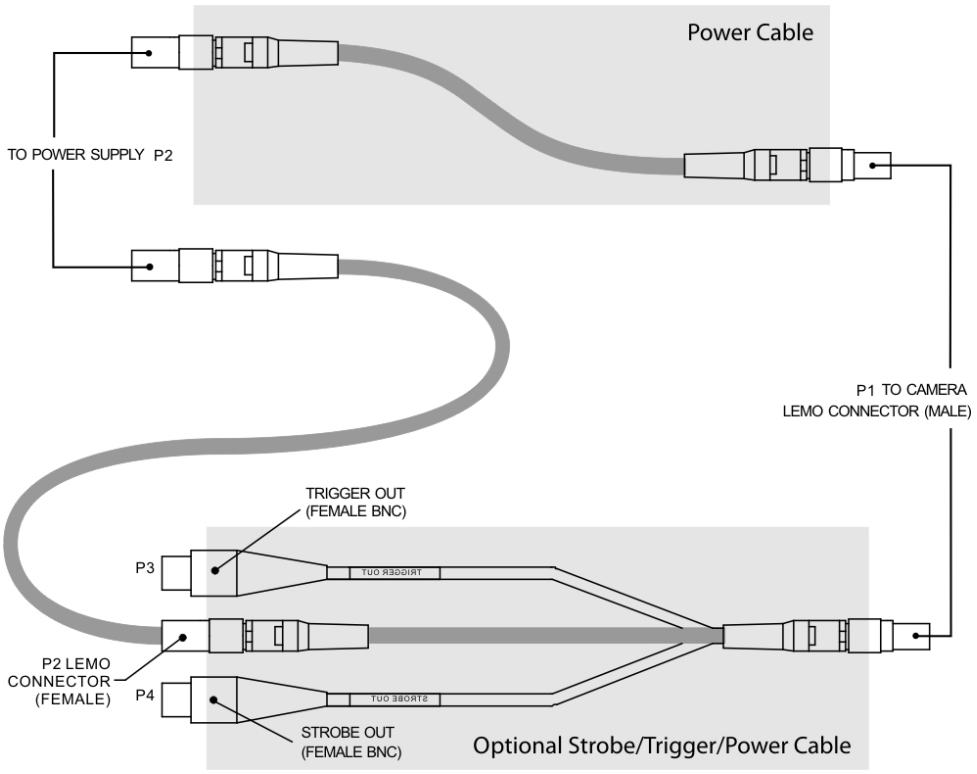
1. First, connect the Power Cable (male end) to the **Power Adapter**.
2. Connect the Power Cable to the camera's Power connector. Connect the power adapter to a standard wall outlet using one of the power cables provided.

NOTE: Line up the "red dots" (●) to ensure proper alignment of the cable and connector.

Connect Optional **Strobe/Trigger/Power** Cable

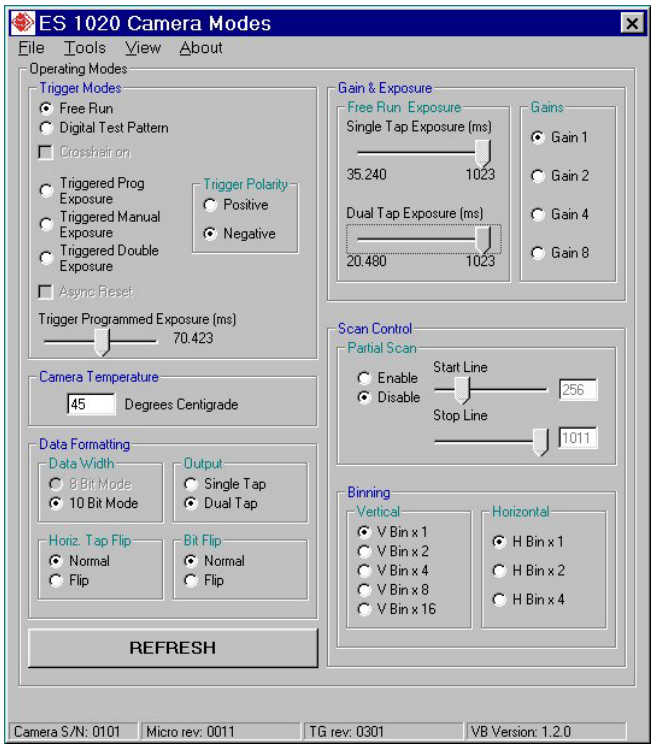
1. First, connect the Power Cable (male end) to the LEMO connector on the **Power Adapter**.
2. Then, connect to the female end of the Power Cable to the camera's Power connector.
3. Finally, connect the power adapter to a standard wall outlet using one of the power cables provided.
4. When the camera is receiving power, the GREEN Power LED will be on. When the YELLOW Activity LED is blinking, it indicates the micro processor is ready to receive a command.

NOTE: The camera is designed with mounting holes on all four outside planes of the camera body, for attaching the mounting bracket. To ensure proper camera orientation when attaching the mounting bracket, pay special attention to the small arrow and the word "up" located on the serial number plate on the rear of the camera.



3. Camera Control Software User's Guide

The ES 1020 Camera Control Software is designed to run concurrently with image acquisition software. Both programs must be installed separately. (See Software Installation.)



Launch Camera Control Software

To launch the ES 1020 Camera Control Software:

1. Double-click on the Redlake icon on your desktop, or click on the ES 1020 Camera Control link located in your start menu.

2. Select the correct "Camera Link DLL" from the drop down when prompted. This is the DLL that corresponds to the Camera Link Frame Grabber board installed.

NOTE: *Launch the Camera Control Software and select the correct Camera Link DLL* ***BEFORE*** *launching the Frame Grabber Board Image Acquisition software.*

Configure Camera Operating Mode Settings

The Graphical User Interface offers access to all the programmable camera functions. The various regions of the GUI are outlined below.

REFRESH Button

This button is for updating the GUI to reflect what the camera is set to. It is used whenever the camera and the software lose synchronization. The following is an example of how the GUI can lose synchronization:

1. Camera powered on
2. Software started
3. Camera settings changed in the software
4. Camera powered off, then on again

At this point, since the camera's settings have not been saved to EEPROM, the software reflects the settings the camera was set to prior to being powered off. Press REFRESH to update the GUI to reflect the camera's actual settings.

If the camera looses communication with the frame grabber board, clicking the REFRESH button with cause the **Select Camera Link DLL** dialogue box to re-open prompting the user to re-establish communications.

Menu Options

File Menu contains the "Exit"

Tools Menu

- **Save Current State to EEPROM** saves current settings to the cameras firmware.
- **Restore to Last Saved State** restores all Operating Modes to the most recently saved settings.
- **Select Camera Link DLL** opens a pop-up dialogue window to allow the user to select or change the Camera Link DLL.

NOTE: *As with any firmware update, the update process must be allowed to finish completely without interruption to avoid firmware corruption. Therefore it is recommended that the user wait a minimum of 10 seconds after the selecting the Save Current State to EEPROM command.*

View Menu allows the user to enable or disable the **Always On Top** option, enabled indicated with a check (✓) mark.

About Menu displays software application release date and build information.

Operating Modes

Trigger Modes

- **Free Run** The camera continuously takes images at its mode dependent frame rate. See Free Run Mode.
- **Digital Test Pattern** appears as a gray ramp with a white grid overlaid on it. The test pattern is very useful in hunting down problems with cables and captures cards.
- **Crosshair on** may be enabled when the camera is in Single Tap Mode; when enabled, white vertical and horizontal lines are overlaid on the video image converging at the center.
- **Triggered Prog Exposure (TPE)** Is used when a predetermined triggered exposure is required. Exposure time (sec) is set by "sliding" pointer along the slider bar. Setting ranges from 0.000 to 0.1216 (sec).
- **Triggered Manual Exposure (TME)** works exactly as the TPE mode with the following exception; the exposure may be extended by keeping the external trigger line asserted.
- **Triggered Double Exposure** works exactly as the TPD mode with the following exception; an additional frame is read out from the sensor.
- **Trigger: Programmed Exposure (sec) Slider** Setting ranges from 0.000 to 0.1216 (sec). The numbers shown in the yellow<alt> text indicate a value for that position on the slider within an arbitrary scale.
- **Trigger Polarity** includes radio buttons to select either **Positive** or **Negative**.

Camera Temperature

- Non-editable text field displaying the current camera temperature.

NOTE: *Camera should be shielded from external heat sources, and should not be allowed to exceed* 65°C.

Data Formatting

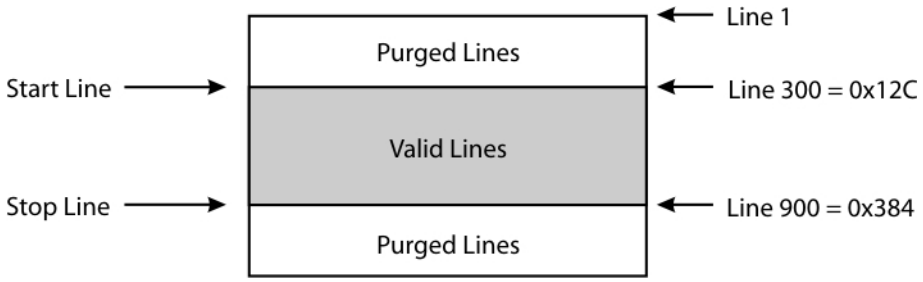
- **Data Width** includes radio buttons to allow the user to select *8 Bit* or *10 Bit* Mode
- **Output** includes radio buttons to allow the user to select *Single Tap* or *Dual Tap* Mode.
- **Horizontal Tap Flip** includes radio buttons to allow the user to select *Normal* or *Flip* Mode
- **Bit Flip** includes radio buttons to allow the user to select *Normal* or *Flip* Mode

Gain & Exposure

- **Free Run Exposure** allows the user to set Single Tap and Dual Tap Exposure using individual sliders with ranges from 0.393 t0 1023. The number shown in the yellow<alt> text indicates a value for that position within an arbitrary scale.
- **Gains** includes 4 radio buttons allowing the user to select Gain values of: 1, 2, 4 and 8.

Scan Control

- **Partial Scan** includes Radio buttons to *Enable or Disable* Partial Scan, a *Start Line* Slider, and a *Stop line* Slider with text displays of numeric setting.



Scan Control: example of Partial Scan

Binning is a special readout mode where the camera 'bins' or combines pixel data. The effect of binning is that the image will have lower resolution but higher SNR, and by using vertical binning the image readout speed is improved. The ES 1020 cameras implement horizontal and vertical binning as separate controls.

- **Vertical** includes 5 radio buttons to allow the user to select Vertical Binning modes including: **V Bin x 1**, **V Bin x 2**, **V bin x 4, V Bin x 8, V Bin x 16**.

- **Horizontal** includes 3 radio buttons to allow the user to select Horizontal Binning modes including: **H Bin x 1**, **H Bin x 2**, **H Bin x 4**.

4. ES 1020 Camera Operations Manual

The following section describes in detail the function of the cable connectors and LEDs located on the rear panel of the ES 1020.

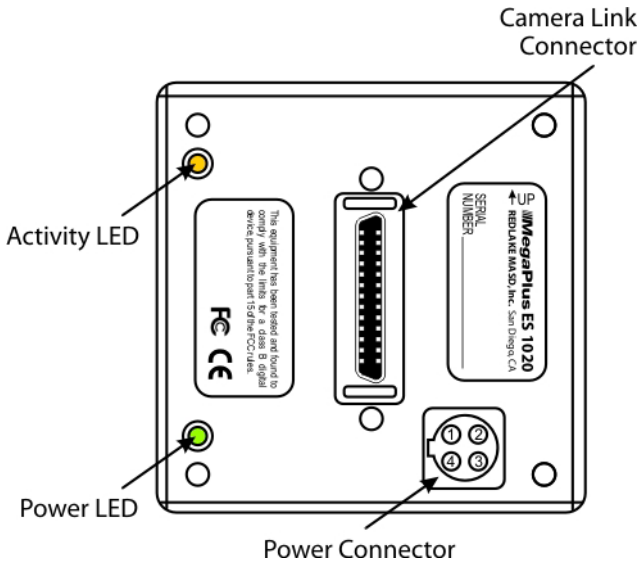
Camera

LED's

There are two LED's on the back of the ES 1020 Camera.

A solid GREEN Power LED indicates that the camera is receiving 12V DC.

A blinking YELLOW Activity LED indicates the microprocessor is ready to receive a command.

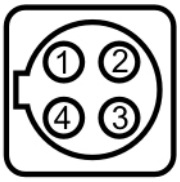


Cables and Mating Connectors

Camera Link
Located in the center of the rear panel of the camera is the CameraLink connector. A similar connector is located on the frame grabber board, and should be accessible on the back of the PC. The CameraLink cable has (2) MDR-26 connectors. Both ends of the cable are the same.

Power
The ES 1020 receives power through the Power Connection also located on the rear panel. This is a 4 pin LEMO™ connector.

PIN 1 = GND
PIN 2 = +12V DC at 400mA*
PIN 3 = Strobe out (Open Collector)
PIN 4 = Trigger **echo** output (3.3V through 1K resistor)



Camera LEMO© Connector
Front View

5. Camera Operation

Factory Settings

The camera is configured at the factory with the following defaults:

- Free Run
- 2 Tap output
- 10 bit output

Negative Trigger Polarity

Implementation

Camera communication is accomplished via asynchronous serial communication according to EIA Standard RS 232 C through the Camera Link cable.

Data rate: Full Duplex, 9800 bps.

- 1 START bit
- 8 DATA bits – The LSB (D0) is transferred first
- 1 STOP bit
- No parity

Protocol

The camera is controlled through command packets. The camera is considered a slave device and never generates data without a read request. The data packet formatting is described in detail below.

NOTE: *The checksum is calculated only on the 4 ascii characters comprising the Data.*

Data Packets

1 ascii character	2 ascii characters	2 ascii characters	2 ascii characters	4 ascii characters	2 ascii characters	1 ascii character	1 ascii character
Start	**Command**	**Target**	**Index**	**Data**	**Check**	**End**	**Ack/Nack**

Start
Indicates the Start of the frame
Size = 1 ascii character
Value = 123 Decimal (ascii {)

Command
Command descriptor
Size = 1 ascii character
Value = 114 Decimal (ascii r) for Read
Value = 119 Decimal (ascii w) for Write

Target
Command descriptor
Size = 2 ascii characters

Index
Command descriptor
Size = 2 ascii characters

Data
The data transferred
Size = 4 ascii characters

Check
Data Checksum - calculated on DATA Only
Size = 2 ascii characters - Intel-Standard - two's compliment of sum.

Example1: Data = 2002, checksum = lower byte of (0x100 – (0x20 + 0x02)) = 0xde
Example2: Data = 0000, checksum = lower byte of (0x100 – (0x00 + 0x00)) = 0x00
Example3: Data = fef0, checksum = lower byte of (0x100 – (0xfe + 0xf0)) = 0x12

End
Indicates the End of the frame
Size = 1 ascii character
Value = 125 Decimal (ascii })

Ack/Nack
Positive acknowledge - Negative acknowledge
Size = 1 ascii character
Ack Value = 33 Decimal (ascii !)
Nack Value = 63 Decimal (ascii ?)

Command Descriptions

Read Command Structure

The camera parses the sequence byte by byte. An invalid read command, target or index will cause the camera to issue an NACK. The Host (You) will generate dummy data with a valid checksum then an end. The camera will respond with an ACK and re send the command with valid data and checksum. If the Host detects an error, it will re issue the command.

Host {r tt ii dummy dummy dummy dummy cc} camera issues !
Camera issues {r tt ii data data data data cc} (NOTE no ACK)

Write Command Structure

The camera parses the sequence byte by byte. An invalid write command, target, index or checksum will cause the camera to issue a NACK, otherwise the write sequence will complete and the camera will issue an ACK after the command has been executed. The camera receives the checksum from the Host.

Host {w tt ii data data data data cc} camera issues !

Error Checking

The camera parser is character by character and will respond with an immediate NACK if any unrecognised command, target, index or checksum occurs.

Communication Timeouts

The camera micro controller uses a hardware watchdog timer that will time out if the time between bytes are longer than 200ms. When sending command frames to the camera the host must not have significant delays between bytes sent.

Normal	< 50ms
Power up BIT	< 4s
Initiated BIT	< 2s
Power up	< 6s

Camera Mode Command Table 1.1

NOTE: *It is recommended to issue a soft reset command after writing to 0400 – 0405. The soft reset command is {w030b000000}. This will ensure that the internal state machine is reset for the new mode.*

Target	Index	**Description**	Operation	Modes
		Camera Control		
04	00	Single Tap Enable	Write	0x0000 = Dual Tap 0x0001 = Single Tap
04	01	Tap Flip	Write	0x0000 = Normal 0x0001 = Flip
04	02	Bit Flip	Write	0x0000 = Normal 0x0001 = Flip
04	03	Trigger Mode	Write	0x0000 = Free Run 0x0001 = Trigger Prog Exposure 0x0002 = Trigger Manual Exposure 0x0003 = TDE
04	04	Test Pattern	Write	0x0000 = Normal Video 0x0001 = Test Pattern
04	05	Binning	Write	0x0000 = Disable all binning 0x0001 = H bin x 2 0x0002 = V bin x 2 0x0003 = H & V bin x 2 0x0004 = H bin x 4 0x0005 = H bin x 1 0x0006 = V bin x 1 0x0008 = V bin x 4 0x000c = H & V bin x 4
04	06	Gain Select	Write	0x0001 = 1 0x0002 = 2 0x0004 = 4 0x0008 = 8
04	07	Camera Temperature	Read	
04	08	Camera actual exposure 10 bit number	Read/Write low speed version ES 1020 Read/Write Low speed version ES 1020	0x0000 =110µsec 0x03ff = 76.32msec (single tap mode) 0x0000 =83µsec 0x03ff = 43.9msec (dual tap mode)
04	09	Partial Scan Enable	Write	0x0000 = Disable 0x0001 = Enable
04	0a	Partial Scan Start Line	Read/Write	0x0010 to 1200
04	0b	Partial Scan Stop Line	Read/Write	Start line + 1 to 1200
04	0c	Micro IBIT initiate – IBIT resets the timing generator, tests ADC read / writes and EEPROM read / writes and reloads camera configuration and sets modes. Clear bit status register prior to execution and check mode registers 1 and 2 and bit status register 1 after executing	Write	0x0000 = Clear Bit Status Register 0x0001 = IBIT
04	0d	Bit Width	Write	0x0000 = 10 bit mode 0x0001 = 8 bit mode
04	0e	Trigger Polarity	Write	0x0000 = negative trigger pulse 0x0001 = positive trigger pulse
04	0f	Crosshair Enable	Write	0x0000 = disable crosshair 0x0001 = enable crosshair
04	10	2x pixel clock Enable (OEM mode)	Write	0x0000 = disable 2x pixel clock 0x0001 = enable 2x pixel clock

		Camera Mode		
05	00	Camera mode status Register 1	Read	Bit 15 1 = v bin x 4 enabled Bit 14 1 = h bin x 4 enabled Bit 13 1 = v bin x 2 enabled Bit 12 1 = h bin x 2 enabled Bit 11 1 = Positive trigger polarity Bit 10 1 = Test Pattern Enabled Bit 9 1 = Partial Scan Enabled Bit 8 1 = ten bit mode enabled Bit 7 1 = 8 x Gain Bit 6 1 = 4 x Gain Bit 5 1 = 2 x Gain Bit 4 1 = 1 x Gain Bit 3 1 = Trigger programmed exposure enabled Bit 2 1 = Bit flip enabled Bit 1 1 = Tap flip Enabled Bit 0 1 = Single Tap Enabled
05	01	Camera mode status Register 2	Read	Bit 15 not used Bit 14 not used Bit 13 not used Bit 12 not used Bit 11 not used Bit 10 not used Bit 9 not used Bit 8 not used Bit 7 not used Bit 6 not used Bit 5 not used Bit 4 not used Bit 3 not used Bit 2 1 = Trigger double exposure enabled Bit 1 1 = IBIT complete Bit 0 1 = Trigger manual exposure enabled

		Camera BIT status		
06	00	Camera BIT Status Register 1	Read	Bit 15 not used Bit 14 not used Bit 13 not used Bit 12 not used Bit 11 not used Bit 10 not used Bit 9 1 = CBIT fail Bit 8 1 = IBIT fail Bit 7 1 = Timing generator failed to configure Bit 6 1 = Watchdog timer timeout Bit 5 1 = Camera loaded from EEPROM (0 = ROM) Bit 4 1 = EEPROM failed read/write test Bit 3 1 = Temp sensor failed read/write test Bit 2 1 = B A to D failed read/write test Bit 1 1 = A A to D failed read/write test Bit 0 1 = Timing Generator failed read/write test

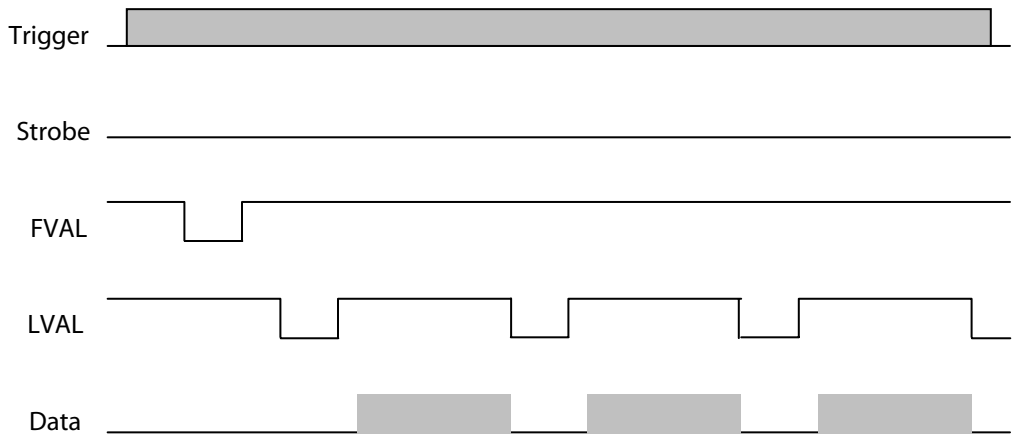
Camera Mode Descriptions

The Camera operates in one of four modes; free run, trigger programmed exposure, trigger manual exposure and trigger double exposure. The mode is selected by writing the appropriate command from the table above.

Free Run Mode

The camera continuously takes images at its mode dependent frame rate. See Tables Appendix E. The camera generates all synchronous timing including FVAL, LVAL, DVAL and pixel data and clocks.

In free run mode (FRM) the camera exposure is calculated in horizontal line times. Thus exposure steps are equal to the camera horizontal line time plus a small overhead for the image transfer into the internal vertical storage CCD.



Free Run Mode

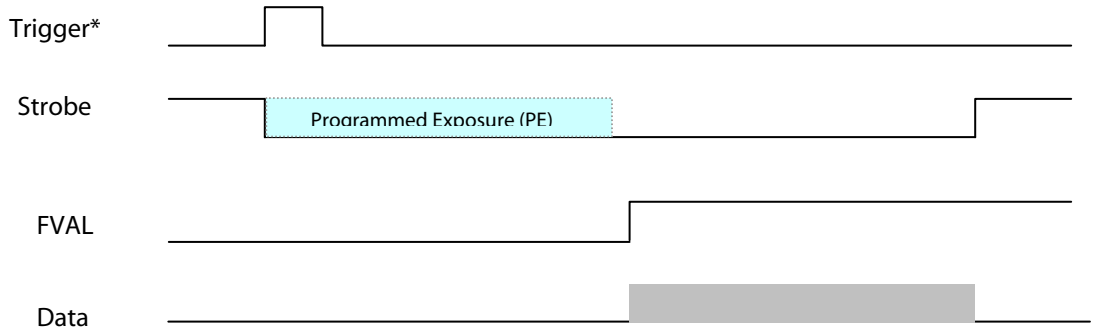
Trigger Exposure Modes

The ES 1020 triggered exposure modes (TEM) work differently from the free run mode in that the TEM is based on the pixel clock (divided by 64) as opposed to the line timing. There are separate exposure registers for the TEM and FRM.

NOTE: Externally triggering the camera may only be done via the Camera Link interface. The Strobe and Trigger cables provide OUTPUT signals only.

Trigger Programmed Exposure (TPE)

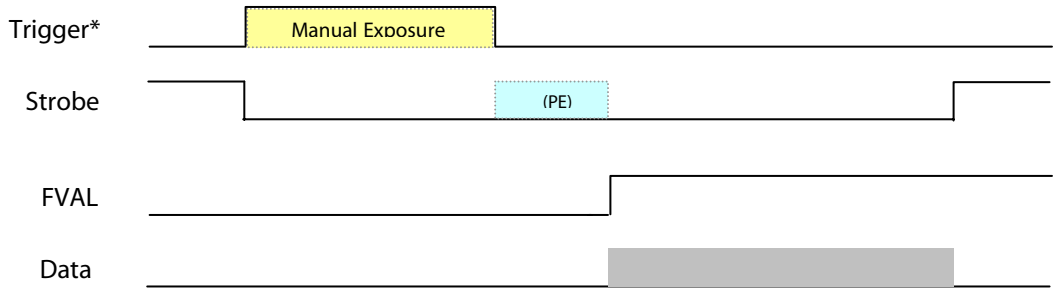
The TPE mode is used when a predetermined triggered exposure is required. The exposure time is programmed into the TPD (Transfer Pulse Delay) register and the TPE mode is set. In this mode, the camera enters a continuous flush mode (CFM) while waiting for the external trigger line to be activated. The external trigger line is sampled and if active, the camera begins an exposure as set by the TPD register. After the exposure period is complete, the image is clocked out. As the exposure is started, the external strobe signal is asserted. The external strobe signal can be used to activate a strobe light.



Trigger Programmed Exposure Mode

Trigger Manual Exposure (TME)

This mode works exactly as the TPE mode with the following exception; The exposure may be extended by keeping the external trigger line asserted. Once the external trigger is de-asserted the ES 1020 completes the programmed exposure (PE) as defined by the TPD register value. To control the exposure in this mode it is recommended that the TPD register be set as small as possible (0x006) so that the camera executes only a very short-programmed exposure after the de-assertion of the external trigger.

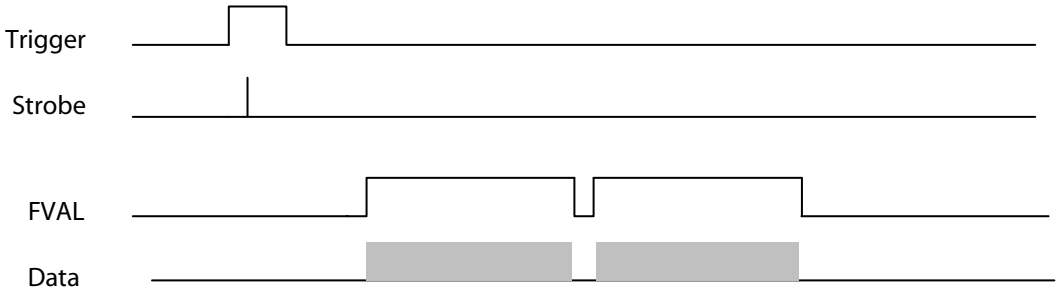


Manual Shutter Mode

- Note that the trigger polarity can be set via command

Trigger Double Exposure (TDE)

This mode works exactly as the TPD mode with the following exception; an additional frame is read out from the sensor.



Triggered Double Exposure

Internal Trigger timing

The trigger timing is based upon three user programmable registers.

(a) Transfer Pulse Delay (TPD): This register sets the time delay from the detection of the trigger pulse to the start of the transfer pulse sequence. The register is used to set the delay in increments of 2112ns. Note that the transfer pulse sequence requires a front pedestal, then the transfer pulse and then a back pedestal. Thus the TPD register cannot be used flash trigger sequences below the pedestal size (40us) without external timing. The range that TPD can be set to is 6 to 65535 dec. (0001 to FFFF hex). This results in a usable delay range from 30us to 138ms.

(b) Transfer Pulse Width (TPW): This register sets the width of the photodiode to VCCD transfer pulse. The register is used to set the width in increments of 33ns. This results in a pulse width of 33ns to 20us. Note that the drive circuitry of the transfer pulse is limited to minimum pulse of about 800ns (A register setting of 0010 hex).

The following diagram illustrates the trigger timing:

6. Maintenance, Technical Support and Warranty

Routine Maintenance

There are no user serviceable parts inside the camera. The camera must be returned to the factory for repair if a malfunction occurs.

The lens and the sensor cover glass should only be cleaned using dust-free compressed air.

Clean the exterior of the camera with a soft, dry, lint-free cloth. For stubborn dirt, the cloth may be dampened with a mild soap solution.

Technical Support

Telephone: 1-800-854-7006 (USA and Canada only)
Outside the USA: (858) 481-8182
Fax: (858) 350-9380
Internet: www.redlake.com

Mailing Address:
Redlake MASD, Inc., 11633 Sorrento Valley Road, San Diego, California 92121-1010

For international customers, please contact your authorized Redlake MASD, Inc. Distributor for information. You may also contact one of the below listed service centers:

Roper Scientific BV (Europe, Middle East and Africa):
Telephone: (31) 347 32 4989
Fax: (31) 347 32 4979
Internet: service@roperscientific.com

Mailing Address:
Roper Scientific BV, Ir. D.S. Tuijnmanweg 10, 4131 PN Vianen, Nederland

Nippon Roper KK, Japan: (For Japan Only)
Telephone: 011-(81) -3-5639 -2770
Fax: 011-(81) -–3 -–5639 -2775
Internet: ishiba@roper.co.jp

Mailing Address:
Nippon Roper KK, 6F Sakurai Building, 2 8 19 Fukagawa Koto Ku, Tokyo, 135-0033, Japan

Warranty

LIMITED WARRANTY

For a period of one (1) year from the date of shipment, the Redlake Product and any Redlake manufactured accessories (collectively the "Product"), shall perform substantially in accordance with the material provisions of the user manual for the Product ("Limited Warranty"). If, because of a defect in workmanship or material, the Redlake Product fails to perform in accordance with the Limited Warranty, then, as the sole available remedy, Redlake shall repair or replace, at Redlake's option, the Redlake Product or any part thereof. The sole remedy of repair and replacement is contingent upon shipment of the Product, within the Limited Warranty period, to Redlake's United States facility. Redlake shall have no obligation under this Limited Warranty to provide local repair or replacement services for the Product, but will, at Redlake's sole discretion, provide repair and replacement service under the terms of the Limited Warranty at its non-United States facilities upon prior written request of the Product Purchaser.

NOTE: THIS WARRANTY DOES NOT APPLY TO THE FOLLOWING CONDITIONS:
(1) damage caused by a failure to operate the Product in accordance with Redlake's written instructions, including, but not limited to, environmental specifications listed in the Redlake user manual; (2) damage caused by accidental user damage, misuse or abuse of the Product; (3) damage caused by the unauthorized attempted repair of or tampering with the Product by non-Redlake personnel; or (4) damage resulting from shipping of the Product.

EXCEPT FOR THE LIMITED WARRANTY STATED IN THIS SECTION, REDLAKE DISCLAIMS ANY AND ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO, ANY WARRANTY OF MERCHANTABILITY, NON-INFRINGEMENT, OR FITNESS FOR A PARTICULAR PURPOSE, REGARDING THE REDLAKE PRODUCT OR ANY PART THEREOF.

IN NO EVENT SHALL REDLAKE BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES, INCLUDING WITHOUT LIMITATION LOSS OF BUSINESS OR PROFITS, EVEN IF REDLAKE RECEIVES NOTICE IN ADVANCE THAT THESE KINDS OF DAMAGES MIGHT RESULT, NOR SHALL REDLAKE'S AGGREGATE CUMULATIVE LIABILITY TO THE PRODUCT PURCHASER, PRODUCT RECIPIENT, OR PRODUCT CUSTOMER, PURSUANT TO ANY AND ALL CLAIMS AND LEGAL THEORIES (INCLUDING NEGLIGENCE AND BREACH OF CONTRACT), EXCEED THE ORIGINAL COST OF THE PRODUCT PAID TO REDLAKE BY THE ORIGINAL PURCHASER OF THE PRODUCT.

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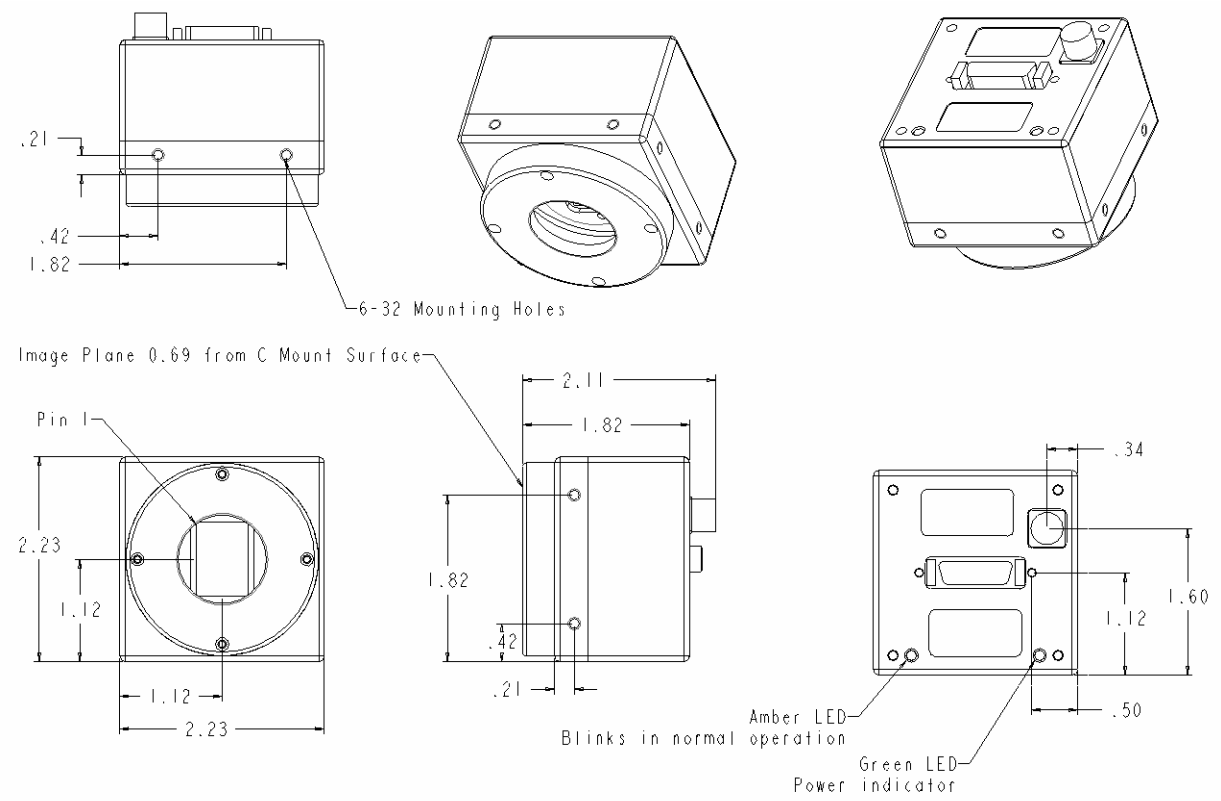
(Redlake MotionCentral and MotionXtra are trademarks.)

Appendix A Case Drawings



*units in inches

ES 1020 Camera Dimensions

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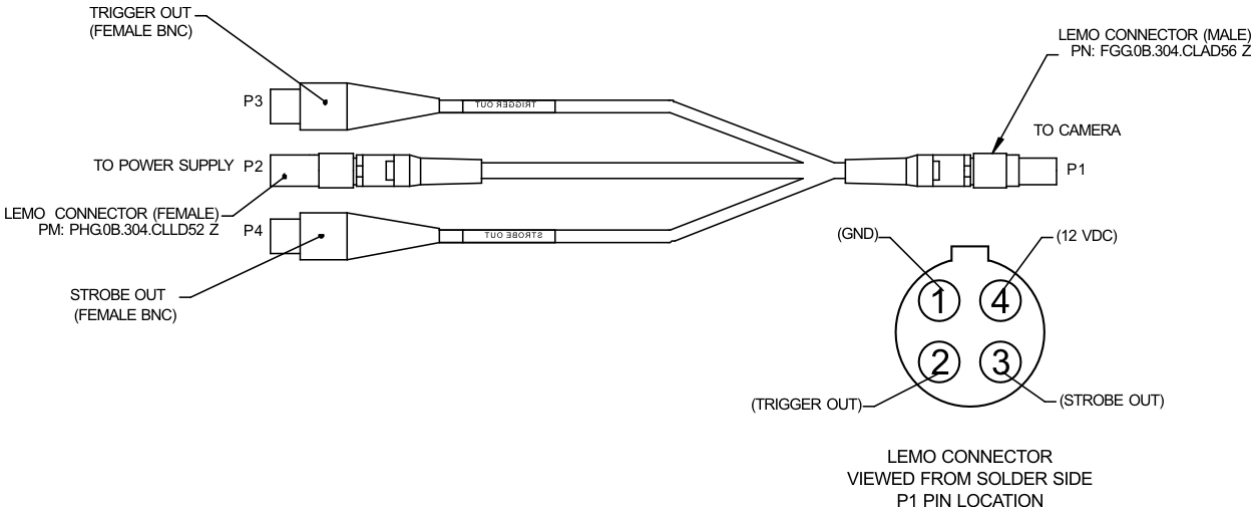
Appendix B Strobe/Trigger/Power Cable



WARNING: Always check the pin out of a custom cable before using it!

The strobe/trigger accessory cable enables access to the camera's output signals located on pins 2 and 3 on the camera power connector. These two outputs provide TTL level trigger pulses. The output signal on pin 3 is generated from with in the camera and used for firing a strobe light. The output signal on pin 2 is used to monitor the trigger signal that arrives to the camera from the Camera Link cable. The trigger output signal on pin 2 is pass-through of the incoming trigger. If no trigger signal is sent from the frame grabber, no signal will be present on pin 2.

NOTE: Externally triggering the camera may only be done via the Camera Link interface. The Strobe and Trigger cables provide OUTPUT signals only.

Terminate unattached female BNC connectors with 50Ω terminators.

To connect the strobe/trigger accessory cable:

Unplug the power connector from the camera if already attached.
Insert the MALE LEMO® connector on the strobe/trigger accessory cable into the camera's FEMALE LEMO® power connector.

Attached the FEMALE end of the strobe/trigger cable to the MALE LEMO® connector located on the power adapter. At this point, the Trigger Out and Strobe Out BNC cables are routing their respective signals out of the camera.

Appendix C Advanced Functions

Timing Generator Control Register 1

15	14	13	12	11	10	9	8
TRIGGER POL	PARTIALSC AN EN	FLIP BITS	SINGLE TAP	TRIGGER ENABLE	TME ENABLE	TDE ENABLE	RESERVED

7	6	5	4	3	2	1	0
TEST PATTERN ENABLE	TG SOFT RESET	8 Bit CL output	TAP FLIP	VBIN 4/2	VBIN ENABLE	HBIN 4/2	HBIN ENBLE

- TRIGGER POL(ARITY)
  Set to 0 for negative trigger pulse
  Set to 1 for positive trigger pulse

- PARTIAL SCAN ENABLE: Single tap output mode for testing
  Set to 1 to enable operation

- FLIP BITS: Flips data bits from msb to lsb
  Set to 0 to enable msb in bit 0
  Set to 1 to enable lsb on bit 0

- SINGLE TAP: Single/Dual tap readout selection
  Set to 1 to enable single tap operation
  Set to 0 to enable dual tap operation

- TRIGGER ENABLE: Select Trigger mode of operation
  Setting this bit to 1 will cause the TG to enter the external trigger mode

- MANUAL EXPOSURE: Manual trigger mode selection
  Set to 1 to enable single tap operation
  Set to 0 to enable dual tap operation

- TDE ENABLE: Trigger Double Exposure Enable
  Set to 1 to enable TDE mode
  Set to 0 to disable TDE mode

- TEST PATTERN ENABLE:
  Setting this bit to 1 will cause the TG to output a fixed gray pattern with grid overlay.
  Set to 0 to disable the test pattern

- TG SOFT RESET: Timing Generator State Machine Reset
  Set to 1 to re-initialize TG state machine
  Set to 0 to resume normal operation

- 8 Bit CL Output (SINGLE TAP ONLY)
  Setting this bit re maps the camera link output to 8 bits per tap.
  The 8 most significant bits of the ADC are used.

- TAP FLIP
  Setting this bit to 1 will cause the TG to flip taps.

- VBIN 4/2: Vertical bin x 2 or x 4
  Set to 1 to enable VBIN x 4
  Set to 0 to enable VBIN x 2

- VBIN ENABLE
  Set to 0 to enable normal operation
  Set to 1 to enable vertical binning

- HBIN 4/2: Horizontal bin x 2 or x 4
  Set to 1 to enable HBIN x 4
  Set to 0 to enable HBIN x 2

- HBIN ENBLE
  Set to 0 to enable normal operation
  Set to 1 to enable horizontal binning

Exposure and Control Register 2

15	14	13	12	11	10	9	8
CR2_3	CROSS HAIR ENABLE	LONG_VBIN	LVDS CLOCK x 2	EXP BIT 11	EXP BIT 10	EXP BIT 9	EXP BIT 8

7	6	5	4	3	2	1	0
EXP BIT 7	EXP BIT 6	EXP BIT 5	EXP BIT 4	EXP BIT 3	EXP BIT 2	EXP BIT 1	EXP BIT 0

- EXP BIT 0 - 11
  Manual Exposure

- LVDS CLOCK x 2 (note: set to 0 for normal operation, set to 1 for 2x LVDS clock)
  Set to 0 to
  Set to 1 to

- LONG V BIN
  Set to 0 to disable V bin x 8 and 16
  Set to 1 to enable V bin x 8 and 16 (Choose via VBIN x 4/2)

- CROSS HAIR ENABLE (note: use single tap mode for cross hair alignment)
  Set to 0 to disable cross hair overlay
  Set to 1 to enable cross hair overlay

- CR2_3

		Timing Generator		
02	00	TG Timing	Read/Write	0x3b54
02	01	TG Control	Read/Write	0x0000
02	02	TG Partial Scan Start	Read/Write	300
02	03	TG Partial Scan Stop	Read/Write	900
02	04	Transfer Pulse Delay	Read/Write	
02	05	Transfer Pulse Width	Read/Write	
02	06	TG Firmware Revision	Read	
02	07	TG Invert Signals	Read/Write	0x0000
02	08	Reserved		
02	09	Reserved		
02	0a	TG Exposure	Read/Write	1150

		Memory Management		
03	00	Save Camera State to User EEPROM	Write (dummy data, correct checksum)	NA
03	01	Load User EEPROM to Camera State	Read (end and ack only)	NA
03	02	Save Camera State to Factory EEPROM	Write (dummy data, correct checksum)	NA
03	03	Load Camera State from Factory EEPROM	Read (end and ack only)	NA
03	04	Load Current Camera State from ROM	Read (end and ack only)	NA
03	05	Read EEPROM Location	Read	
03	06	Reload Xilinx and restart camera	Write	
03	07	Save Tap Matching Array to Fact and User EEPROM	Write	0x0000 = Save Gain =1 to user and factory 0x0001= Save Gain = 2 to user and factory 0x0002=Save Gain = 4 to user and factory 0x0003 = Save Gain = 8 to user and factory
03	09	Save tuning data to Factory and User EEPROM	Write	0x0000 = Save un binned timing to factory and user EEPROM 0x0001 = Save hbinx2 tuning to factory and user 0x0002 = save hbinx4 tuning to factory and user
03	0a	INIT camera no Xilinx reload	Write	
03	0b	Soft INIT Xilinx	Write	0x0000 = Normal operation 0x0001 = Init state machines

		Camera Mode		
05	00	Camera mode status register 1	Read	
05	01	Camera mode status register 2	Read	

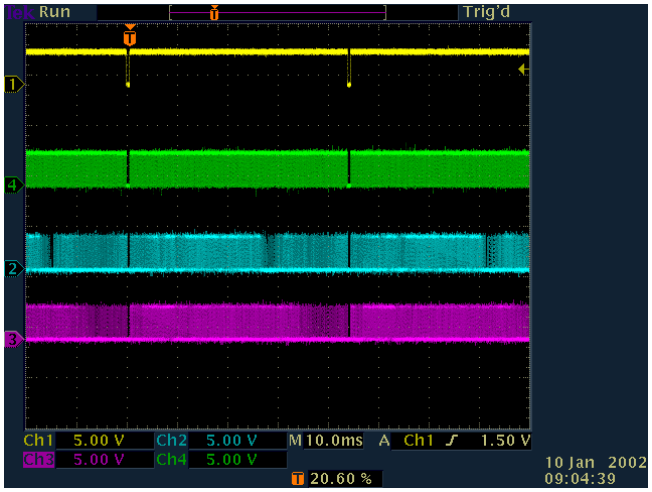
		Camera BIT status		
06	00	Camera BIT Status Register 1	Read	
06	01	Camera BIT Status Register 2	Read	

		Camera Configuration		
07	00	Camera Model	Read/Write	
07	01	Camera Revision	Read/Write	
07	02	Camera Serial Number	Read/Write	
07	03	Micro firmware version	Read	
07	04	Timing Generator firmware version	Read/Write	
07	05	Overall Software Version	Read/Write	
07	06	Clear EE Init flag	Write	

Appendix D Camera Timing

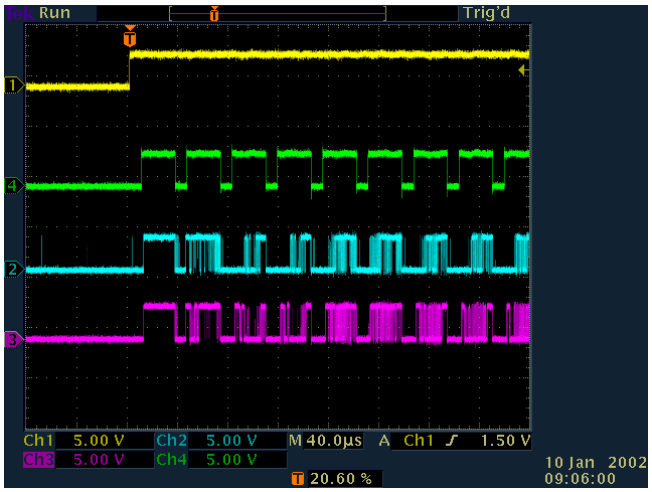
ES 1020 Timing Specifications

Free Run Electronic Exposure	One Tap	Two Tap
Master Clock	34.4Mhz - 29ns period	34.4Mhz - 29ns period
Frames/Sec	28.37	48.83
H Active Pixels	1004	502 x 2 Taps
H Count	1194	692
H Active Time	29.24us	14.65us
H Sync Time	5.561us	5.561us
H Line Time	34.9us	20.21us
V Active Lines	1004	1004
V Count	1010	1010
V Active Time	34.98ms	20.31ms
V Sync Time	269.3us	167.1us
V Frame Time	35.24ms	20.48ms



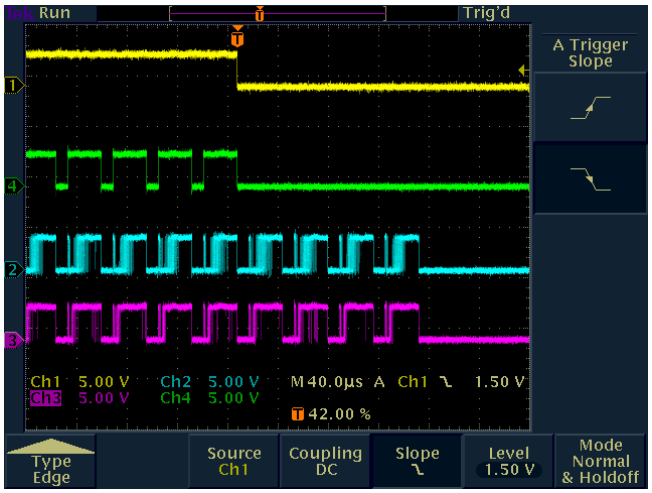
Free Run Timing

Yellow = FVAL, Green = LVAL, Blue = Tap L, Red - Tap R



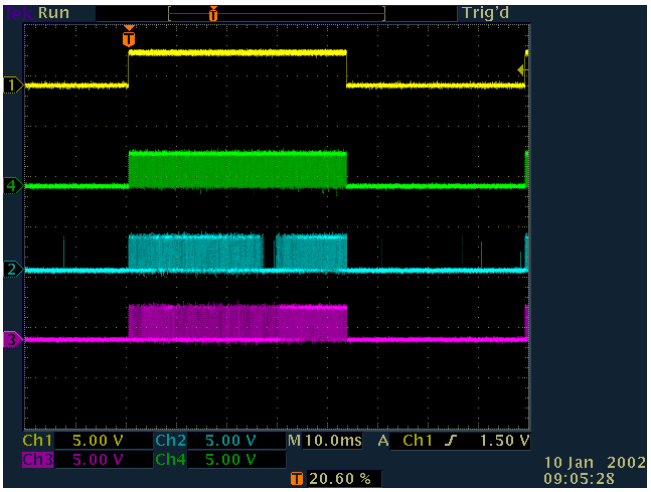
Free Run Timing: Start of Frame

Yellow = FVAL, Green = LVAL, Blue = Tap L, Red - Tap R



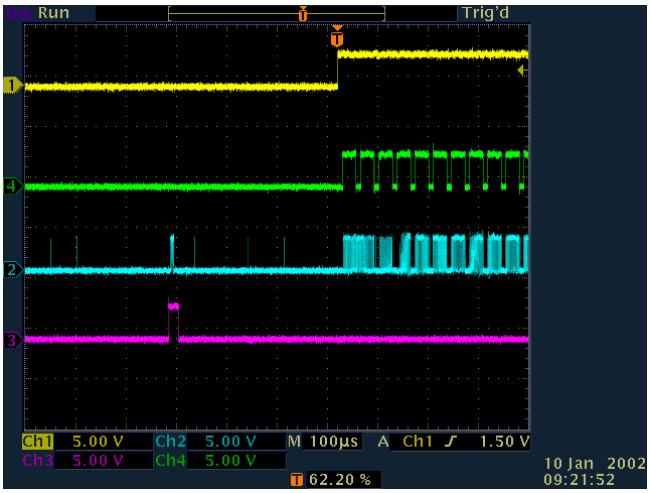
Free Run Timing: End of Frame

Yellow = FVAL, Green = LVAL, Blue = Tap L, Red - Tap R



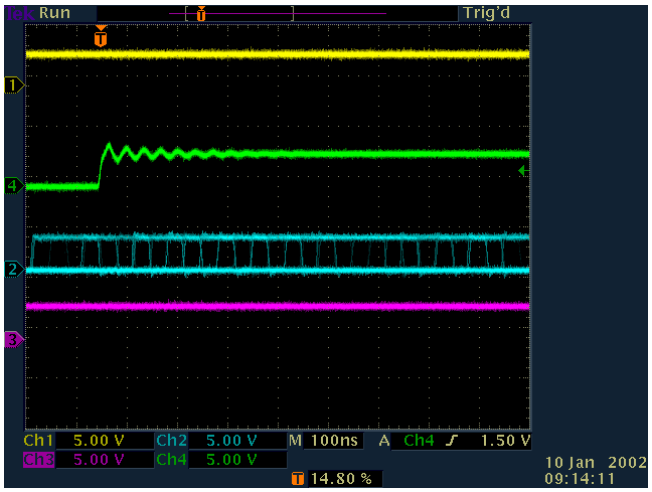
Triggered Timing

Yellow = FVAL, Green = LVAL, Blue = Tap L data bit, Red - Tap R data bit



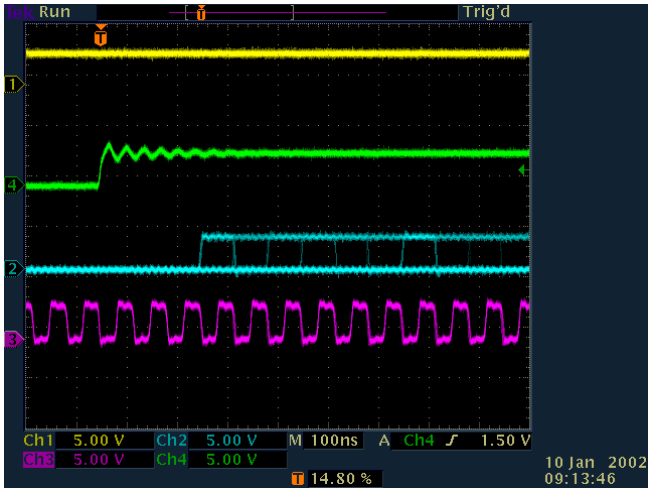
Triggered Timing: Start of Frame

Yellow = FVAL, Green = LVAL, Blue = Tap L, Red - Trigger



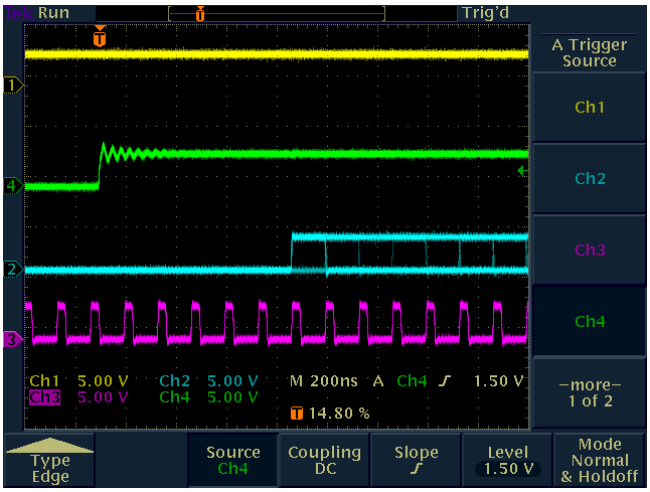
DVAL Timing: Binning off

Yellow = FVAL, Green = LVAL, Blue = Tap L, Red - DVAL



DVAL Timing: 2X Horizontal Binning

Yellow = FVAL, Green = LVAL, Blue = Tap L, Red - DVAL



DVAL Timing: 4X Horizontal Binning

Yellow = FVAL, Green = LVAL, Blue = Tap L, Red - DVAL.